REMARKS

Claims 1-16 were rejected. Claims 8-15 have been withdrawn from consideration as being directed to non-elected subject matter. Claims 1, 3, 5, 7 and 16 are amended and new claims 17-23 added. A substitute specification is also submitted herewith. Support for the amendments, new claims and substitute specification can be found throughout the application, for instance at pages 13 (lines 19-22) and 14 (lines 3-4) of the specification and in the claims as originally filed. With respect to claims 16 and 23 in particular, Applicants point out that "contact" of the porous membrane with solution is easily recognized by those of ordinary skill in the art from the separation process disclosed for example at page 14 (lines 3-4) of the specification. No new matter is added. Claims 1-7 and 16-23 are submitted for further consideration at this time. Applicants respectfully request reconsideration and withdrawal of all rejections in light of the remarks below.

Claim Rejections - 35 U.S.C. §112, first paragraph

It is alleged that a substitute specification is required to correct certain grammatical and format errors in the specification. A substitute specification and marked up copy of the substitute specification showing changes to the specification are submitted herewith. Applicants respectfully urge that the substitute specification is correct and proper under current patent practice.

Claims 3-7 were rejected under 35 U.S.C. §112, first paragraph, as not being enabled. It is alleged that those of ordinary skill in the art would not be able to make and use a porous membrane as claimed without the recitation of further steps. Applicants respectfully point out that this rejection is moot in light of the amendment of claim 3 indicated herein. Applicants urge withdrawal of the rejection.

Claim Rejections - 35 U.S.C. §112, second paragraph

Claims 1-7 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite. It is alleged in the Office Action that the term (per)fluorinated is unclear because it is unknown whether Applicant is attempting to claim perfluorinated polymers, or in the alternative, fluorinated polymers which are optionally fluorinated. Applicants respectfully disagree. Applicants point out that the term (per)fluorinated is recognized by those of ordinary skill in the art to mean that the polymers can be perfluorinated or fluorinated, that is, the polymers do not contain or otherwise still contain hydrogen atoms attached to carbon atoms. The term (per)fluorinated therefore refers to both fluorinated polymers and perfluorinated polymers. Applicants note that it is well known to those of ordinary skill in the art that a "perfluorocarbon" compound is a compound wherein the hydrogen directly attached to the carbon atom is replaced by fluorine.

It is alleged that the term "porosity" is unclear, because porosity is art recognized as being a measure of total pore volume of a membrane, not individual pore size. Applicants respectfully disagree as the term "porosity" is clear when read in view of the application as a whole. Applicants point out that claim 1 indicates that porosity, in the range 5 - 500 nm, is determined by an atomic force electron microscopy. Applicants further point out that in Example 1, the specification (page 15, lines 22-23) states that pore size or pore diameter, expressed in nm, is determined by an atomic force microscope. Applicants therefore respectfully submit that it is quite clear to those of ordinary skill in the art viewing the application as a whole that the term "porosity" refers to pore size.

It is also alleged that use of the phrases "preferably" and "such as" renders claims 1, 5, 7 and 16 unclear. Applicants urge that this point is moot in light of the claim amendments indicated herein.

Finally, it is alleged that claim 16 is indefinite in reciting a use without any active, positive steps delimiting the use. Applicants urge that this rejection is also moot in light of the amendment of claim 16 indicated herein.

Applicants urge that all claims are clear and definite.

Claim Rejections - 35 U.S.C. §101

Claim 16 was rejected as being improper under 35 U.S.C. §101. It is alleged in the Office Action that the recitation of use without setting forth any steps results in the improper definition of a process. Applicants respectfully point out that this rejection is also moot in light of the amendment of claim 16 indicated herein. Applicants urge that claim 16 is a proper process claim and request withdrawal of all rejections.

Claim Rejections - 35 U.S.C. §102

Claims 1, 3, 5, 7 and 16 were rejected under 35 U.S.C. §102(e) as being anticipated by Banerjee (U.S. Patent No. 5,795,668). It is alleged that Banerjee discloses a membrane (and use of the membrane) made from a perfluorinated amorphous polymer mixture.

Applicants respectfully disagree. Applicants have now been able to investigate films made of (per)fluorinated amorphous polymers that can be used for separation processes having improved porosity, and that are obtainable by inexpensive industrial processes. The present invention is therefore directed to porous membranes of (per)fluorinated amorphous polymers having a porosity in the range 5 - 500 nm, determined by an atomic force electronic microscope, wherein 80% - 90% of the pores have a size ranging from minus 5 nm to plus 5 nm of the value of the distribution maximum peak. The porous membranes

of the present invention are suitable for application in separation processes such as ultrafiltration and nanofiltration, for instance in separating a solute from organic solvents or gases dissolved in aqueous liquid. The membranes can also be used as contact membranes having a high productivity. As can be seen from the Examples 1-5 in the specification, the permeability of the membranes to gases is a quite high.

As noted throughout the specification, films and membranes of the porous membranes of (per)fluorinated amorphous polymers are preferably prepared by a process including: a) preparation at room temperature of a solution of an amorphous polymer in a fluorinated solvent; b) spreading of the solution on an inert support; and c) solvent evaporation at a constant temperature, generally comprised between 10° C - 40° C, preferably at a room temperature lower than 10° C - 45° C with respect to the solvent boiling temperature, for 1 to 10 days. That is, through such a process it is possible to obtain the porous membranes having a pore average size distribution which is narrow, about 80% - 90% of the pores having a size ranging from minus 5 to plus 5 of the value of distribution maximum peak.

In contrast to the present invention, Banerjee discloses a fuel cell incorporating a reinforced ion exchange membrane disposed therein. The membrane comprises: a) a porous support layer, preferably a fluorine containing polymer having a pore diameter of from about 0.05 to 10 μm and a ratio between the volume occupied by pores to the entire volume of the porous material from 50 to 95%; and b) one or more polymeric ion exchange resins, preferably in the form of layers supported on either or both sides, and preferably having a thickness less than about 250 μm. The fuel cell of Banerjee may use a liquid or gaseous fuel, preferably a liquid hydrocarbon fuel. The porous support layer may be made of fluorine-containing polymers, which can be both crystalline (i.e., PTFE) and amorphous

fluoropolymers, or hydrocarbons such as polyolefins. With respect to crystalline fluoropolymers, microporous PTFE can be used, usable porous PTFE having a pore size of 0.2 micron. The amorphous polymers are a copolymer of TFE with perfluoro-2,2-dimethyl-1-1,3-dioxole, or dioxole homopolymers.

With respect to the preparation of the porous support layer, Banerjee discloses the following. First, mixing the fluorine containing polymer with a pore forming agent, forming the polymer into a film, then extracting and removing the pore forming agent. Second, forming a mixture of the fluorine polymer and a liquid lubricant, such as kerosene oil or fluorine oil, into a membrane by extrusion and rolling, followed by monoaxial or multiaxial stretching treatment. Third, (a) contacting at a temperature in the range of about 250° - 400° C PTFE with a fluid which penetrates and swells; (b) cooling an separating the penetrated, swollen polymer from unabsorbed fluid; and (c) removing the absorbed fluid to form a porous film. It is noted that the various examples of Banerjee demonstrate that the reinforced fuel cell membrane comprising the porous support are permeable to the liquid fuel (methanol).

However, despite such disclosure the Banerjee reference cannot be considered to teach or suggest the present invention. Applicants point out in particular that Banerjee contains no teaching or suggestion of average pore size distribution in the porous membrane according to the claimed invention. A proper determination of anticipation requires the disclosure of each and every claimed element. Applicants also point out that the manufacturing process for the porous membrane of Banerjee is different from that of the present invention, at least as none of the disclosed processes make use of a solution of the polymer in a fluorinated solvent. Indeed, in the processes of Banerjee, mixtures of polymers are used with selected liquids, the mixtures then processed as indicated by the steps described above. In addition, Applicants point out that the porous membranes of

Banerjee are different from the membranes of the present invention, as demonstrated by the various examples, in that the membranes are permeable to liquids. As a consequence, unlike the membranes of the present invention, the membranes of Banerjee are not suitable for separating a solute from organic solvents or gases dissolved in an aqueous liquid. The cited Banerjee reference simply does not teach or suggest any invention as claimed.

Claim Rejections - 35 U.S.C. §103

Claims 1-7 were rejected under 35 U.S.C. §103(a) as being obvious over Flottmann et al. (U.S. Patent No. 4,923,608) in view of Resnick et al. It is alleged that Flottmann et al. discloses a membrane made from polymer films (including fluoropolymer films) having specified pore size. Resnick et al. is cited as disclosing amorphous TEFLON AF capable of being vaporized by a laser.

Applicants respectfully disagree. Flottman et al. discloses flat membranes formed from foils of organic polymers, glass or ceramic materials, with a fixed pore diameter of less than 10% and an arrangement of the pores in a configuration of adjacent rows, wherein the average pore diameter ranges from 0.05 to 10 micron, the pore patterns arranged uniformly within a regularly bounded area. Organic polymers suitable for use according to this reference include polyolefins, polycarbonates, polyesters, polyimides, PMMA, polyformeldehyde, PTFE, cellulose and silicon rubber. The maximum relative area fraction that can be occupied by holes is disclosed as being about 50% relative to the total membrane, the holes being of a funnel-shaped structure.

According to the manufacturing process as disclosed by Flottman et al., an entire field of several thousand holes is drilled concurrently by a laser beam with a spatial expanded beam area that is intensity-modulated therein. The spots with high intensity correspond to the holes, while the spots with low intensity correspond to the ribs that remain

between the holes. This particular hole pattern is accomplished for instance by means of a grid of a metallic shadow mask, that is optically reduced by means of a lens system and projected with the laser onto the substrate foil. The desired hole pattern is created when interference lines that are perpendicular to one another cross over, the substrate foil being continually transported at low speed under the stationary laser head.

Nevertheless, as noted at page 3 of the Office Action, the Flottmann et al. reference contains no teaching or suggestion of any amorphous perfluoropolymer. Applicants note that it is well known that polytetrafluoroethylene (PTFE) may be used in Flottman et al., as the prior art including Resnick et al. disclose PTFE as a highly crystalline polymer. However, Applicants emphasize that the teaching of PTFE is no teaching or suggestion of fluorinated amorphous polymers, that is, PTFE has nothing to do with fluorinated amorphous polymers. Applicants point out that a substantial difference resides, as illustrated by Figure 22-17 of Resnick et al., in that the gas permeability of PTFE is either very low or almost non-existent. For instance, Resnick et al. discloses that the gas permeability to CO_2 is 12 Barrer (1200 centi-Barrer at Figure 22-17), to oxygen is 42 and to nitrogen is 1.4. Applicants emphasize that such numbers are from one hundreds to one thousands lower than those numbers presented in Table 2 for the membranes of the present invention. Applicants therefore note that those of ordinary skill in the art might have some motivation to use a highly crystalline polymer such as PTFE, which is scarcely permeable or almost impermeable to gases, for effecting the treatment according to Flottmann et al. However, Applicants respectfully submit that those of ordinary skill in the art would have no motivation to modify the treatment according to Flottman et al. with amorphous polymers (e.g., TEFLON AF) as disclosed by Resnick et al., for at least the following two reasons. First, as noted above, the teachings and suggestions of Flottman et al. are expressly directed to PTFE (i.e., TFE homopolymer) and not TFE coplymers.

Indeed, Flottman et al. contains absolutely no teaching or suggestion regarding TFE copolymers. Second, the amorphous TFE polymers (e.g., TEFLON AF) cited by the Examiner with reference to Resnick et al. are materials already permeable to gases. Accordingly, those of ordinary skill in the art would not be motivated to include such material in any treatment according to Flottman te al., as this reference is addressed to the manufacture of flat membranes with identical pores. Applicants point out that in the case of TEFLON AF, pores already exist in the membrane of the amorphous polymer, and therefore, further treatment according to Flottman et al. would not result in a uniform pore size distribution, as desired by the Flottman et al. reference. Moreover, it would not possible to obtain pores with a size lower than 50 nm with any process according to Flottman et al. Applicants therefore respectfully submit that not only does no combination of Flottman et al. and/or Resnick et al. yield the present invention, but that those of ordinary skill would have not motivation to combine these cited references.

As a final matter, Applicants note that at page 8 of the Office Action it is stated that TEFLON AF is capable of being vaporized by a laser. This statement appears to address that part of Resnick et al. which states that laser ablation is a technique by which a material is vaporized in a high-vacuum environment and the vapor directed to a substrate for coating (page 415-416). The advantages of this technique is that extremely thin films can be deposited without using solvents. Resnick et al. goes on to state that this technique has been successfully applied to TEFLON AF (page 417). However, Applicants respectfully point out that such disclosure appears to have nothing to do with the teachings of the Flottmann et al. reference, that in contrast uses a laser beam to make holes of 50 - 10,000 nm in a foil sheet. Again, Resnick et al. is unable to cure any of the deficiencies of Flottmann et al., and therefore Applicants respectfully request withdrawal of all rejections.

In view of the amendments and remarks above, Applicants submit that this application is in condition for allowance and request reconsideration and favorable action thereon.

In the event this paper is not considered to be timely filed, Applicants hereby petition for an appropriate extension of time. The fee for this extension may be charged to our Deposit Account No. 01-2300, along with any other fees which may be required with respect to this application.

Respectfully submitted,

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Enclosures: Marked-Up Copy of Claim Amendments
Substitute Specification (1 clean and 1 marked-up)
Petition for Extension of Time

MARKED UP COPY OF CLAIM AMENDMENTS

Claim 1 (Amended). Porous membranes of (per)fluorinated amorphous polymers having a porosity in the range 5 - 500 nm, [preferably 20 - 100 nm,] determined by an atomic force electronic microscope, wherein 80% - 90% of the pores have a size ranging from minus 5 nm to plus 5 nm of the value of the distribution maximum peak.

Claim 3 (Amended). Porous membranes of (per)fluorinated amorphous polymers according to claim 1, the (per)fluorinated polymers selected from the group consisting of [obtainable from the polymerization]:

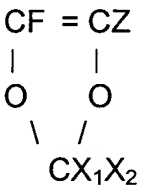
A) polymers of one or more monomers having structure (II):

$$CF_2=CY_1CY_2 \qquad (II)$$

wherein: Y_1 and Y_2 are selected from F, Cl, CF_3, OR_f

wherein R_f is a C_1 - C_5 perfluoroalkyl radical;

with one or more comonomers having the following structures:



(I)

wherein: Z is selected from F, R_f, OR_f [, preferably OR_f]; R_f is a perfluoroalkyl radical C_1 - C_5; X_1 and X_2 are selected from F and CF_3;

bisvinyloxymethanes having structure (III):

$$CFX^1=CX^2\text{-}O\text{-}CX^3X^4\text{-}O\text{-}CX^2=CX^1F \qquad (III)$$

wherein X^1 and X^2, equal to or different from each other, are F, Cl [, preferably F]; X^3 and X^4, equal to or different from each other, are F or CF_3;

dienes having structure (IV);

$$CF_2=CF-O-(CF_2)_n-CF=CF_2 \qquad (IV)$$

wherein n = 1 - 5 [, preferably 1 - 2];

or

B) homopolymers of monomers having structure (I) or (III) or (IV);

C) copolymers of monomers having structure (I) or (III) or (IV).

Claim 5 (Amended). Porous membranes of (per)fluorinated amorphous polymers according to claim 3, wherein the dioxole percentage having structure (I) is in the range 40% - 90% by moles [, preferably 50% - 85% by moles].

Claim 7 (Amended). Porous membranes of (per)fluorinated amorphous polymers according to claim 3, wherein the monomers having structure (II) are selected from tetrafluoroethylene, perfluoroalkylvinylethers (C_1-C_5), hexafluoropropene, chlorotrifluoroethylene [, tetrafluoroethylene (TFE) is preferably used].

Claim 16 (Amended). [Use of the porous membranes of (per)fluorinated amorphous polymers according to claim 1 in separation processes such as ultrafiltration, nanofiltration and as contactor membranes] A ultrafiltration or nanofiltration separation process wherein a solution containing a solute is contacted with the porous membrane of claim 1.